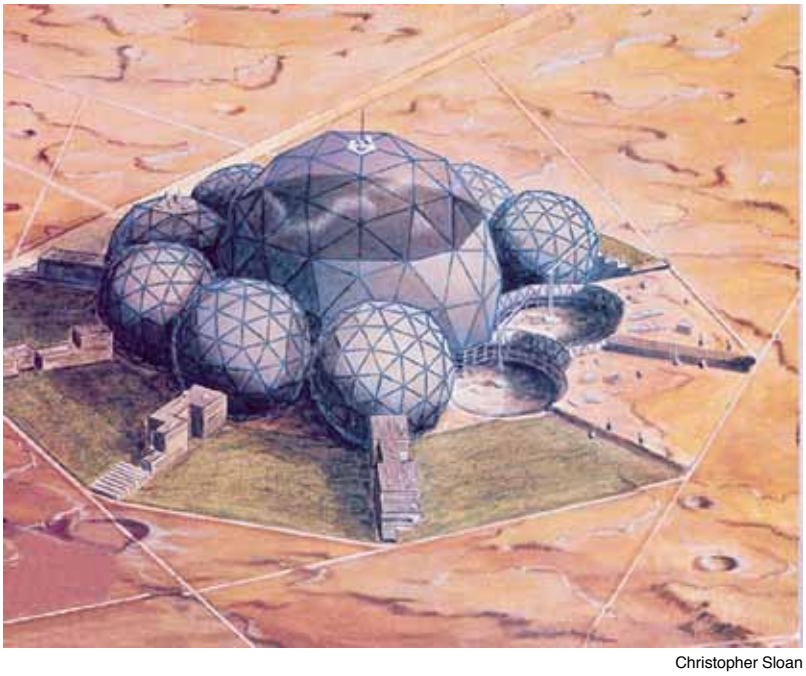
Your Life on Mars

by Michael James Carr



Christopher Sloan

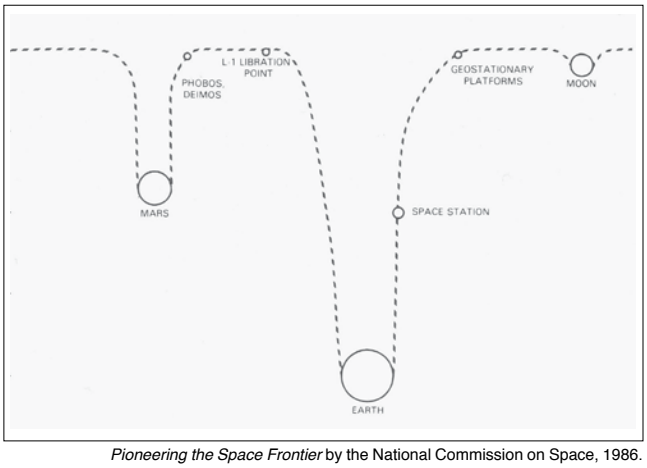
An artist's conception of Lyndon LaRouche's vision of a city on Mars.

Feb. 2—As with the case of water slowly heating up, almost imperceptibly, until it goes through a phase change, suddenly becoming powerful steam, the recent decades have seen a slow but steady accumulation of decisions, actions and discoveries which are about to make mankind a multi-planetary species.

Of course this is not accidental, but the deliberate result of the individual initiatives of outstanding people too numerous to mention, but at least a few should be remembered with extraterrestrial cities towns and stations named for them—Konstantin Tsiolkovsky, Wilbur and Orville Wright, Robert Goddard, Hermann Oberth, Wernher von Braun, Sergei Korolyov, Krafft Ehricke, and of course Lyndon LaRouche—for their persistence against all odds in working towards creating the future we are now entering. We hope to increase the value of their work by our successful leaps forward now, just as the actions we take now will only achieve complete success via the succeeding transformations to be made by our descendants.

The day is not far off when LaRouche's science city will be operating on Mars and Krafft Ehricke's Selenopolis, a lunar industrial city, will export water and hydrogen and oxygen, as well as structures and vehicles made of the abundant titanium, magnesium and iron found there. Once a minimal human/robotic division of labor is established on the Moon, the Moon has the advantage of having the lowest transfer costs from the surface to Low Earth Orbit (LEO) and anywhere else in space. It is so easy to use a simple MagLev launch track to move anything from the lunar surface to lunar orbit. And it's even easier to head anywhere else from lunar orbit.

In the process of mining water and minerals, the processing will also accumulate large quantities of lunar Helium-3 (exceedingly rare on Earth), which is the perfect fuel for fusion power and especially fusion propulsion systems. Since all products of Helium-3 based fusion are electrically charged, the reaction products are easily directed out of a rocket via magnetic nozzles. It is this Helium-3 which makes possible safe human travel to Mars in just a few days.



Pioneering the Space Frontier by the National Commission on Space, 1986.

The relative effort required to reach Low Earth Orbit in the vicinity of the Space Station, is much greater than that required to achieve Geostationary Orbit on the Moon. The relatively small Gravity Well of the Moon makes it an ideal pit stop to pick up supplies and fuel en route to anywhere else.

CC/Steve Jurvetson

Fish and vegetable farming at Edenworks in Brooklyn, New York. Similar indoor farming methods will operate underground on the Moon. Can we get plants or forests to grow on the Martian surface?

Fusion rocket powered passenger tugs featuring continuous acceleration, and slower freight tugs, will bridge the distances between the orbiting transfer stations above Earth, Moon and Mars. Between Earth and LEO, passengers fly aboard spaceplanes that make such connections as simple as today's airline operations. For bulk freight deliveries to LEO, shipments are launched via a superconducting MagLev launch track called the StarTram. On the Moon and Mars, reusable rocket-powered pods link the surface to the orbiting transfer stations.

LEO, Moon and Mars based universities and research labs spin off more and more new industries to develop new processes and discoveries into valuable products of trade.

Starting on the Moon, underground farms will provide vegetables, while meats and grains will come in from Earth in exchange for the lunar exports. Like the lunar farms, Selenopolis will be located beneath the lunar surface for passive protection from radiation and meteorites. But the experience on the Moon will provide the exciting prospect of turning Mars green. Could we find plants that could survive on the open surface of Mars with a little help from man? Besides the greenhouses to be built there, could we get plants or lichens growing in the thin Martian atmosphere? The thin atmosphere is 95% CO_2 (good plant food), but the weather is very cold most of the time. Could we artificially intervene to warm Mars? Place solar reflectors in orbit to increase the temperature in growing areas? Either way, we begin with the systems perfected on the Moon.

What are the effects of living in the new cities on these heavenly bodies? How do the children develop? How is human thought and culture altered? Where could we set up colonies after Mars? These are questions to be answered further down the line. In the meantime, we are moving into the immediate future of an Earth-Moon-Mars economy. The era of geopolitics and predatory financial schemes is over. The era of interplanetary Man, the New Paradigm, begins. We review here some important transition points in this process.

Oligarchical control is failing because normal productive people have been abused to the limit of their tolerance are now beginning to think outside the oligarchy's prescribed patterns. It is also failing because Lyndon LaRouche spent his life teaching all who would listen. He developed plans for the industrialization of every backward area on Earth. He taught his most advanced ideas to the poorest people and nations as well as to the prosperous.

He applied a related idea of Nicholas of Cusa to global problems—that the greatest potential of each individual and each nation can only be realized if *all* are developed to the maximum possible. LaRouche insisted that each country, however poor, must seek to leapfrog into the most advanced areas of science; that each nation should have its own space and research institutions. Work on the frontiers of science will drive a society to its better future.

The combination of LaRouche's decades of interventions and the desire of people everywhere to solve their problems and move onward and upward has outflanked the oligarchy. More than seventy nations have national space agencies seeking to participate and contribute in some way to the spread of civilization outward from Earth and to advance their own productivity and prosperity.

In particular, once poor and backward, China is coming forth with plans to develop the resources of the Moon (including Helium-3) as an integral part of a new

economy compassing both Earth and the Moon. India has a satellite orbiting Mars and is about to send its first astronauts into space aboard its own newly developed spacecraft. Rather than such initiatives leading to competition and conflict, the result is a spur to unified efforts to take up the challenge posed by Lyndon LaRouche in 1987, when he proposed a forty-year project to build a science city on Mars.

And now amazing progress is ongoing—not yet everything required, but still quite a leap forward from ten to twenty years ago. Within the next several months, the International Space Station (ISS) will have two new taxi services added to the existing *Soyuz*. This summer will see four spacecraft from four different international teams head off to Mars. Russia will soon launch its first nuclear powered "space tug" as an important contribution to the cislunar space infrastructure. There are many such projects that demonstrate the opportunities open to those young people willing to take up the exciting challenges ahead.

From Above

Back in 1987, when Lyndon LaRouche laid out a plan to build a science city on Mars over the course of forty years, he insisted that the city's purpose would be to build and manage a fleet of telescopes positioned along the ecliptic of the Mars orbit around the Sun to enable a synthetic telescopic aperture with the diameter of the Martian orbit. The point was, and still is, that what humanity knows is extremely miniscule as compared to what we really need to know. Are we blindly speeding through space?

But first, before going further to discuss ongoing progress, we must digress a moment to deal with the oligarchical hangover. As LaRouche outlined, the full Moon-Mars project requires a return to regulated banking (Glass-Steagall prevention of looting of savings in commercial banks), and the establishment of national banks with authority to create credit for investment in approved categories of productive activity and infrastructure. Also, a New Bretton Woods agreement with fixed exchange relationships between national currencies will be necessary to allow for long term international productive investments that protect all sides from currency manipulations. These measures will require the minimal cooperation of Presidents Trump, Putin and Xi, as well as Prime Minister Modi and other leaders able to come forward in building the new, non-predatory world economic/financial system.

These economic underpinnings are necessary, because without regulated banking and currencies fostering productive investment, investments in frontier areas come only as "equity investments" which give venture capitalists controlling influence over the activities of entities working in frontier areas of science and production. We need functioning public credit and currency systems to allow scientists, engineers and production people to make the future-oriented decisions needed for the most rapid progress. Over and over we have seen equity investors stop needed long-term investments, in order to loot the short-term returns of industry.

Secondly, we must establish the metric for comparison of ongoing efforts with the requirements of the updated overview of the Krafft Ehricke-Lyndon LaRouche space program presented in "Moon-Mars Crash Program Under a Four-Power Agreement," in the October 26, 2018 *EIR*. It says, in part,

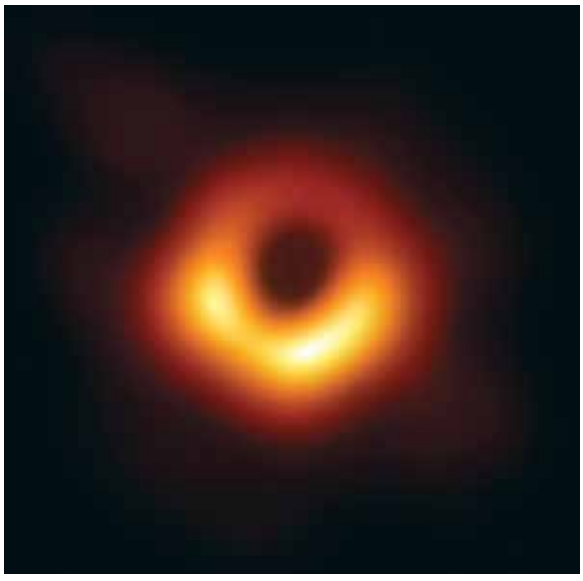
> As with the Apollo Project of the 1960s, we are dealing with a critical path of problems to be solved. Each solved problem affects all of the subsequent problems in the path; nevertheless, we don't tackle these problems sequentially, but simultaneously. In this way, as unknowns are resolved, workable architectures begin to appear out of the haze of uncertainty. The problems to be overcome are huge but manageable. Here are some:
>
> - Compact fusion and fission propulsion systems
> - Routine spaceplane access to Low Earth Orbit (LEO) for humans and delicate hardware
> - Completely new, heavy-lift maglev launch technology
> - Removal or control of LEO space junk
> - New construction techniques for Lunar and Martian settlements
> - Technologies to "live off the land" on the Moon and Mars
> - Mining and manufacturing technologies
> - Technologies for space farming and food preparation
> - Air and water recycling and creation
> - Healthcare in space
> - Space defense against harmful radiation and meteorite impacts
> - Psychological effects of long-term separation from Earth

- Physiological and psychological effects of childhood development on the Moon and Mars.

Since about 1967, which saw funding for the Apollo Project peak, along with the beginning of the British Tavistock Institute's all-out assault on American scientific progress, the American space program has turned away from pursuing revolutionary "best solution" technologies, towards "cost effective" or "off the shelf" derivative technologies instead. Yet, "off the shelf" technologies actually tend to cost more—because they do not lead to revolutionary effects throughout the rest of the economy. For the space program does not return revenue paid out by the Man in the Moon or by little green Martians, but rather through the transformation of the Earth's economy by new ideas and technologies transmitted out of the program.

It is this conveyor belt of new technologies and optimism fed into the American economy which led to returns of far more than $10 for each dollar invested into the revolutionary Apollo program. And, even this is really a faulty measure of value, because the power at the command of one dollar before Apollo was much inferior to the power at the command of a dollar after Apollo had transformed the technologies of every area of product and production.

Having understood this much, it is best practice to put resources into multiple possible solutions for a problem (even into apparently "far out" possible solutions), because the successful revolutionary solution will more than pay for the other failed solutions. And in fact, the economic consequences of such "failures" can be enormously beneficial.



European Southern Observatory

This image, created by the Event Horizon Telescope, a planet-scale array of eight Earth-based radio telescopes, revealed the first direct visual evidence of a supermassive black hole and its shadow, fifty-five million light-years from Earth in the center of Messier 87, a massive galaxy in the Virgo cluster.

Astronomy

In April 2019, the international collaboration of eight astronomical facilities around the world which, together, constitute the Event Horizon Telescope, succeeded in creating the first image of the horizon around a black hole (emissions of matter just before it is sucked into the hole region itself).

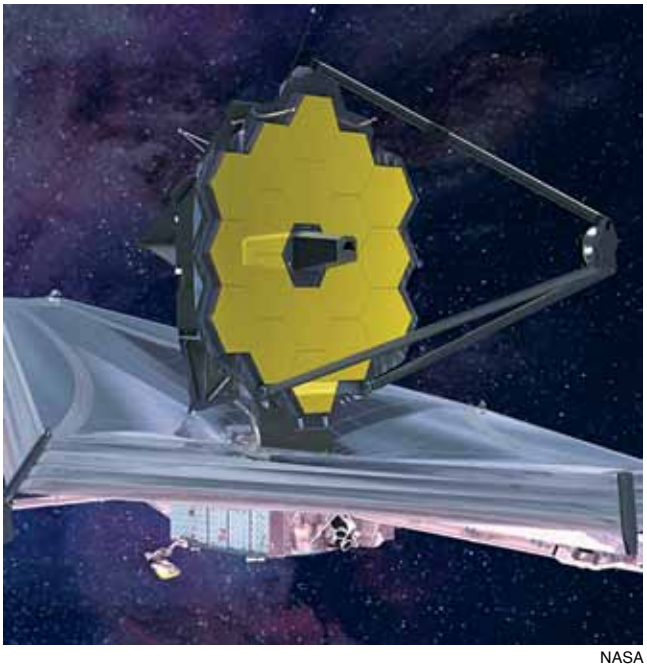
In 2018, the 64-dish radio telescope MeerKAT began operation in South Africa. The MeerKAT will soon be linked with a radio telescope system in Australia to create the seed crystal of the twenty-nation intercontinental Square Kilometer Array (SKA). Over time this system will have a collecting space (synthetic aperture) of one square kilometer.

At the end of 2019, the Netherlands-China Low Frequency Explorer (NCLE)—far removed from Earth-based radio noise aboard the CNSA (China National Space Agency) Chang'e-4 Queqiao relay satellite—began a radio-frequency mapping of the heavens.

The Chinese five-hundred meter Aperture Spherical Telescope (FAST, nicknamed Tianyan, "Eye of the Sky"), a radio telescope, began began operational work in January 2020. It is the largest single-reflector radio telescope in the world.

Xinhua Press

China's Five-hundred meter Aperture Spherical Telescope (FAST).



NASA

An artist's rendering of the James Webb Space Telescope in action.

In March of 2021, the James Webb Space Telescope, a joint NASA-European Space Agency-Canadian Space Agency project, is expected to be launched on an Ariane rocket to begin its study of the heavens in the infrared spectrum. Its resolution is expected to top that of the Hubble Space Telescope, whose images suggest that there are at least ten times more galaxies than previously thought—perhaps 100 to 200 billion galaxies! The Webb Telescope will orbit the Sun a million miles further out from the Sun than Earth.

In 2023, the Giant Magellan Telescope, composed of seven of the largest monolith mirrors in existence, is expected to begin observations from atop a mountain in Chile. It is expected that images from this system will be ten times sharper than those from the Hubble Space Telescope. It will overcome the distortions introduced by the intervening atmosphere by using a computer-aided technique called speckle interferometry.

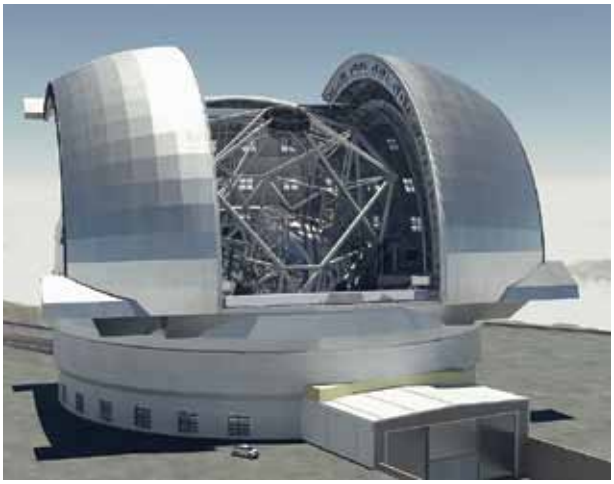
Atop another mountain in Chile, the European Extremely Large Telescope, with 798 hexagonal mirror segments combining to create a primary mirror thirty-nine meters across, is expected to begin observations in 2024.

Other important systems are both operational and planned for the near to medium future. The excitement created by the Hubble's revolutionary discoveries and the demonstrated new capabilities for pointing mirrors with extreme precision created wide support in the world public and even inside governments to proceed to build the dream machines of astronomers. You can see that LaRouche's Mars orbit aperture telescope proposal is only a few steps beyond what is already in progress.

Besides the dreams, there are also nightmares to contend with, such as the risk of Earth's collision with large asteroids or comets. In 2013, after the meteor explosion above Chelyabinsk, Russia, the International Asteroid Warning Network was established to pool global resources to track such threats and propose countermeasures. Also in 2013, NASA's Planetary

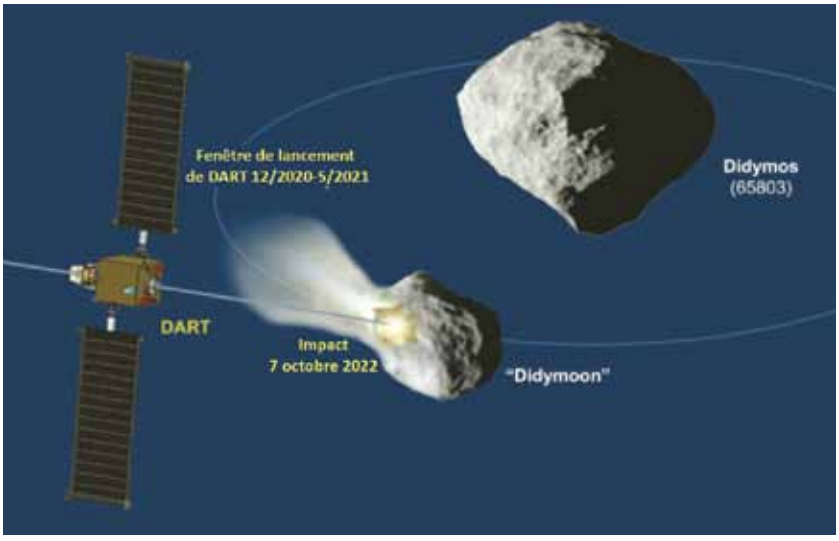
GMTO Corp.

Artist's concept of the completed Giant Magellan Telescope, situated in the Atacama Desert, 115 km (71 mi) northeast of La Serena, Chile.



European Southern Observatory

An artist's conception of the Extremely Large Telescope.



NASA

A schematic view of the Double Asteroid Redirection Test (DART) mission.

Defense Coordination Office repurposed an orbiting infrared telescope along with other assets to seek out and map potentially hazardous Near Earth Objects. In 2021, the office will launch the Double Asteroid Redirection Test (DART) Mission aboard a SpaceX Falcon 9 and accelerate into deep space using solar electric propulsion systems to the moonlet of the near Earth asteroid Didymos to test out the effectiveness of kinetic collision in altering asteroid orbits. The 2022 collision will be monitored by Earth-based telescopes and radars to determine the effects of the impact.

If one millionth the effort expended upon the nonexistent "Global Warming Crisis" were applied to Planetary Defense, humanity would *truly* be safer. This work needs to be greatly expanded. Giant meteor or comet impacts on Earth are indeed a nightmare scenario for civilization.

Mars and Deep Space

This summer of 2020 will see the Earth-Mars relationship approach its biennial optimal launch trajectory configuration. This time around, four spacecraft will be launched for Mars:

1. NASA's soon to be renamed *Mars 2020* rover—a derivative of the Mars *Curiosity* rover with some new features, including autonomous driving capabilities and a small helicopter

2. CNSA's Mars orbiter and rover atop a Long March V launcher, which recently returned to operational status

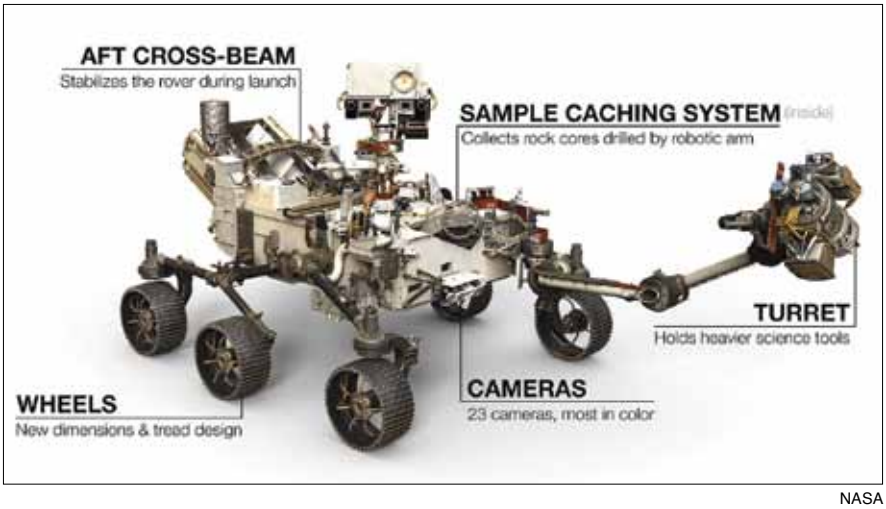
3. European Space Agency (ESA) and Russian State Corporation for Space Activities (Roscosmos) rover, named *Rosalind Franklin*

4. The United Arab Emirates' Mars orbiter, named *Hope*, being built in Colorado, to be launched on a Japanese rocket this summer.

These spacecraft will join the already existing human infrastructure at Mars: NASA's *Curiosity* rover and NASA's three orbiters, the ISRO's (Indian Space Research Organization) *Mangalyaan*, ESA's *Mars Express*, and the joint ESA/Roscosmos *ExoMars*. The 4 new Mars spacecraft will launch and then "coast" for months on force-free trajectories until reaching the vicinity of Mars. This is fine for these early scouting robots but unacceptable as a means of human transport to Mars.

Fission and Fusion

On the surface of Mars, the *Curiosity* rover and the new NASA rover turn the heat generated by the natural process of radioactive decay of Plutonium-238 dioxide into the electricity needed to power the rover operations. BWX Technologies (formerly Babcock and Wilcox) is developing more powerful, but still compact, small-scale nuclear reactors that could power anything from orbital space stations to bases on the Moon



NASA

NASA's Mars 2020 *Rover.*

or Mars. Russia's Roscosmos has announced that in 2030 it will launch a nuclear-powered tug spacecraft for deep space operations. Such vehicles are ideal for moving freight between Earth and Lunar orbits. Fission-powered rockets (called nuclear thermal rockets or NTRs because they use the heat of nuclear fission to heat an inert gas to approximately twice the temperatures and exhaust velocities of chemical rockets) could halve the travel-times to Mars, but that is still months.

Work in Russia and at the U.S. Department of Energy and NASA's Marshall Space Flight Center should continue and expand in these areas, but the minimal solution for sending even initial astronauts to Mars (not to mention building bases and cities on Mars) is with the continuous, dense production of energy and propulsion thrust with thermonuclear fusion.

Fortunately, despite Congressional refusal to fund a serious American effort in fusion, progress around the world and at various companies has nevertheless brought this technology to the verge of initial space and commercial utilization. We list a few of the important areas of work in this area:

1. Work proceeds with NASA backing at Princeton Satellite Systems (a spinoff of the Princeton Plasma Physics Laboratory) on an actual fusion rocket engine called the Direct Fusion Drive.

2. In France, the International Thermonuclear Experimental Reactor (ITER), a giant international tokamak, is slowly being assembled. "First plasma" is scheduled for 2025 and first deuterium-tritium fusion operations in 2035, with the goal of reaching an energy gain of 10 times the energy input. This conservative design was put together in the 1990s with the intent of creating the design and manufacturing capabilities to build actual fusion power plants. However, as this process develops, breakthroughs are taking place that cause many fusion researchers to see potentially quicker pathways to operational fusion power.

3. In Cambridge, Massachusetts, with the recent breakthroughs in manufacturing high temperature superconductors, work at the Massachusetts Institute of Technology in high-temperature tokamak superconducting magnets has spun off a new company, Commonwealth Fusion, which is building new superconducting magnets that will go into a much, much smaller machine called SPARC, which will be the first net energy producing fusion machine. Beyond that, the company intends to build the first actual fusion power plant, the ARC.

4. In Palmdale, California, Lockheed Martin's Skunk Works is developing a small fusion reactor that could power ships, planes and small cities. It builds a new design of test reactor every year or two, and has now finished its fifth device. It expects to build three more generations of test devices before producing a prototype usable reactor.

5. China's new HL-2M Tokamak is expected to become operational this year, reaching sustained plasma temperatures of 200 million degrees Celsius, and taking off from the work of its EAST tokamak which currently holds the world record for tokamak plasma confinement time. It is designed to test out ideas which will be used in the ITER. China has announced plans to start building a demonstration fusion power plant in five years, which it expects to begin generating electricity by 2040.

6. Canada's General Fusion has announced that it has raised $200 million (mostly from private investors) to allow it to build a prototype of its unusual vortex fusion machine.

7. Germany's Wendelstein 7-X stellarator fusion device is expected to demonstrate a thirty-minute plasma confinement time next year.

8. England's Tokamak Energy is working with new high-temperature superconducting magnets to produce a small reactor it hopes could generate electricity in 2030.

9. TAE Technologies, in California, expects to demonstrate net energy output in the next few years with its proton-boron fusion technology.

The imminence of commercially viable fusion power systems is indicated by the fact that there are twenty-one private companies who are members of the Fusion Industry Association, each working on unique fusion designs for practical application. And, not all companies working on fusion are in this association. We've mentioned a few of them above, but the technology is right on the cusp of producing practical machinery for accomplishing work. If you are a resourceful young person willing to apply yourself, this is the main missing link in allowing the spread of civilization to the Moon and Mars. Seize the opportunity to make history!

That Wall Street and other venture capitalists are beginning to invest in some of these companies means that fusion development has broken through the tired lies that fusion will always be fifty years away from realization. However, what has been missing is the commitment by the U.S. government to accelerate the pro-

cess with significant direct funding, and for final sprints from prototypes to production: Large-scale, cheap credit is needed, as outlined in LaRouche's Four Laws.

JAXA

Concept from a joint Japan Aerospace Exploration Agency (JAXA)-Toyota study for a lunar vehicle carrying two astronauts. JAXA is one of many agencies and companies interested in working in the Artemis program.

The Moon

Last year President Donald Trump put the establishment of the first permanent human presence on the Moon on an accelerated timetable. The program was given the name "Artemis" and has the goal of putting astronauts back on the lunar surface by 2024 and establishing a permanent presence by 2028. For Artemis, the Moon is not an end in itself, but a testing ground and logistical base for the later human operations on Mars and beyond.

LaRouche and Ehricke go well beyond that concept to insist that the low gravity of the Moon and the availability of water, Helium-3, and relatively high concentrations of metals there will make the industrialization of the Moon and development of lunar resources key to all human space operations and settlement. The Moon is the perfect spaceship shipyard and fueling station. The Artemis program is a good start in the direction of lunar industrialization, but industrialization will require propulsion breakthroughs and more political (and financial) support.

These are some goals of Artemis :

1. International collaborative project: At least 26 nations have expressed interest in participation. (It will be important to bring China into this project.)

2. Open architecture: All systems (such as docking systems, communications systems, etc.) are designed with open standards to allow any nation or company to participate.

3. Demonstration of the ability to extract lunar resources, such as water, from lunar regolith.

4. Development of the infrastructure (such as the Lunar Gateway orbiting waystation, which can function as a movable supply depot for lunar, as well as Martian operations).

5. Development of multiple private freight delivery systems to the Gateway and to the surface. For example, NASA has a pool of fourteen companies with which it can contract delivery of payloads to the lunar surface. So far, two companies have been contracted to deliver two payloads of science and engineering experiments in 2021.

In 2019, China's *Chang'e-4* lander sprouted the first Earth seedlings on the Moon.

China has just delivered its new, as yet unnamed, human-rated spacecraft capable of Earth-orbital as well as deep space operation, to the Wenchang launch center for uncrewed testing. At some point in the near future it will fly an unmanned test aboard a Long March VB variant of the Long March V. It is designed to accommodate up to six people. A fuller review of China's

Roscosmos

A mockup and test vehicle of Roscosmos' Orel *deep space crew module on display at the Moscow Air and Space Show in August 2015.*

NASA

The NASA Space Launch System core stage moves from production to firing tests.

space plans is available here.

Russia has also been working on a new-generation, deep-space human spacecraft in the Orel program. The first unmanned tests are expected in 2023 and the first manned mission in 2025. It is expected to carry up to four cosmonauts out past Earth orbit.

This year NASA's Space Launch System (SLS) core stage is being tested before its first flight around the Moon with an unmanned Orion spacecraft, which is scheduled for 2021. The complete SLS is the most powerful rocket ever built.

Low Earth Orbit

As of November 2020, the International Space Station (the most complicated project ever undertaken), will have been manned for twenty years. During this time, it has served as a testbed for many technologies, including wastewater recycling into drinking water and on-orbit manufacturing.

The logistical requirements of maintaining six astronauts and a very large facility in orbit, have required continuous freight and crew delivery service. Since completion of the main ISS architecture and the retirement of the space shuttles in 2011, cargo has been lofted by the Russian Progress, Japanese HTV, European ATV, and American Dragon and Cygnus cargo transfer spacecraft, while crew transportation has rested upon the reliable Russian Soyuz system.

This year, the Soyuz will be joined by the SpaceX Crew-Dragon spacecraft and the Boeing Starliner. With the recent successful completion of its In-Flight Abort Test, the Crew-Dragon spacecraft will be ready for its first manned launch to the ISS by the end of February. The actual launch date has not yet been scheduled, but March or April would be a good guess. The Starliner will also make its first manned launch to the ISS this year, but the timing has not been announced.

As these new transport services begin to prove themselves, NASA intends to rent out manufacturing space and facilities aboard ISS to industries seeking to test microgravity production systems for products such as special metals, optical fibers, growing replacement organs, etc. As some of these production systems develop, it would be expected that some companies would want their own factories in space, which would be serviced by the SpaceX, Boeing and perhaps other commercial space transportation systems. This is primarily dependent upon the ability of SpaceX and Boeing to perfect their operations to the point that companies can consider space-based production to be an affordable and reliable proposition.

NASA/Bill Ingalls

The NASA/Boeing Starliner spacecraft shortly after landing, after its first unmanned flight test in 2019.

Axiom Space

An artist's conception of Axiom's space station, to be constructed while attached to the ISS, then detached, to form an independent commercial research complex.

On January 27, 2020, NASA announced that it will make a docking port on the ISS available to an American company called Axiom Space. The company will attach to the ISS several commercial modules it intends to build, including a node which will connect to multiple habitation, research and manufacturing modules. Eventually this complex could disconnect from the ISS and become its own separate commercial space station. Axiom Space is founded by, and teamed with, many individuals and companies with long experience on ISS.

Next year, the Sierra Nevada Corporation's Dream Chaser spacecraft will bring back the ability, lost after the shuttle retirement, of gently landing delicate cargo from the ISS on a runway.

In 2019, Reaction Engines of England achieved its goal of cooling incoming Mach 5 air down to temperatures suitable for use in a rocket motor—thus taking the place in the early stages of flight, of heavy onboard Oxygen. This means that air-breathing space planes that take off from a runway, fly to orbit, and land back on a runway, are now possible to build. Reaction Engines has garnered over £100 million of investment, but this breakthrough demands crash program funding from the American government to design and build a complete, integrated spaceplane with this technology. This will make human access to orbit as safe and easy as flying across the Atlantic or Pacific.

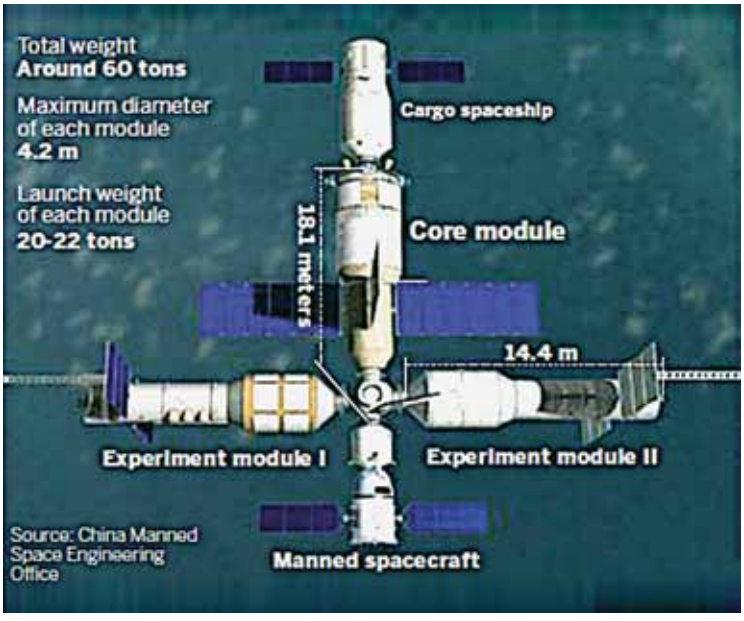
In September of 2019, the Tianhe ("Harmony of the Heavens") core module of the Chinese Space Station (CSS), was declared ready for service by the China Manned Space Agency (CMSA). Now that the Long March V rocket is back in service, launch could occur by sometime next year, with full completion of the multi-module station to take place over a two-year period following launch of the Tianhe module.

Another American company, Bigelow Aerospace, is offering to build inflatable orbital laboratories or factories for governments or private industry. It has had one of its inflatable modules in service on the ISS since 2016 and is aiming to build part of the Lunar Gateway way-station envisioned in the Artemis program. It also aims to provide structures for Lunar and Martian surface operations.

Near the end of 2021, India is expected to launch its first astronauts into orbit aboard its new spacecraft, *Gaganyaan*. If successful, India will become the fourth nation to independently develop a human spaceflight system.

While it is very important in all respects that nations develop as much of their own productive potentials as possible, it is also important to stress the importance of international cooperation in the huge efforts involved in developing civilization on the Moon and Mars. The so-called Wolf Amendment, which prevents NASA and Chinese aerospace officials from directly meeting one-on-one to work out cooperative arrangements must be repealed! A step in the right direction will be the April 2020 State Department meeting between U.S. and Chinese aerospace officials, but it is just ridiculous that space officials can only meet when chaperoned by State Department officials.

Also, in 2025, the European Space Agency (ESA) will launch an active debris removal mission called



China Manned Space Engineering Office

Diagram of China's Tianhe Space Station.

ClearSpace-1, which will grab onto a large piece of debris in Low Earth Orbit and de-orbit it. It is a test before developing reusable systems for clearing up debris in Low Earth Orbit.

Freight to Low Earth Orbit

The development and deployment of now over 1,000 cubesats—tiny modular spacecraft made up of "cubes" measuring 10 cm x 10 cm x 11.35 cm—has created the new possibility for schools and the economically poorer countries to cheaply launch their own satellites. These can piggyback on larger satellite launches and open up Low Earth Orbit for many types of new uses. For example SpaceX is engaged in launching a system of thousands of tiny satellites in LEO which will bring space-based internet connectivity to nearly every spot on the globe. It is not the only such space-based internet swarm of satellites. So many are flying and soon to fly that astronomers are beginning to complain about streaks across their images caused by rapidly moving, low altitude satellites. Many new launch companies have formed, specifically for the purpose of launching small satellites into LEO.

Most interesting among these new companies is the California-based SpinLaunch. In 2019 it received its first U.S. government contract for a launch; it also broke ground on a new launch facility in New Mexico. It will begin test flights this year and commercial launches in 2022.

Its technology is closely held, but here is a speculative description. Like the StarTram concept, it externally imparts kinetic energy to a projectile on the ground and releases it upward into space, whereupon a small rocket burn is used to place the projectile into final orbit. Unlike the StarTram concept, this projectile would be small and accelerated around a circular or spiral track before being flung outward and upward. It is not clear how the energy is imparted: whether it is by magnetic fields or by a physical centrifuge. SpinLaunch seeks to attain a launch frequency of five times per day and a cost in the neighborhood of $250,000 per launch.

Success of this SpinLaunch system could lead to the general realization that the larger scale StarTram concept must be built in order to ship the massive tonnages of freight that construction of bases and cities on the Moon and Mars will require.

Concluding Thoughts

There is much more that is not covered here, such as SpaceX's Starship project, Blue Origin's New Glenn, Virgin Galactic, Virgin Orbit, and even electric propulsion. Nor did we mention the one hundred or so new Chinese companies developing space systems. Nor did we discuss all relevant projects of the more than seventy space agencies of the world. It were impossible to cover everything—even were we omniscient. The good news is that *so much is in flux and development*. The point of this report is to bring to your attention the most incredible potentials of the immediate future. There is no reason to abuse drugs or alcohol. Tune your antennae to the incredible opportunities all around you and find a place in which you can make a contribution!

There is still quite a gap between what is required, as outlined by the updated Ehricke-LaRouche program, and what is happening now and on the near horizon; however, the gap is closing and the power of the opposition networks is failing. Add your voice to Helga Zepp-LaRouche's call for Presidents Trump, Putin and Xi to meet! This meeting must not only deal with hot spots and creation of the new fixed exchange-rate monetary system, but also work out even closer international cooperation in the drive to civilize the Moon and Mars.